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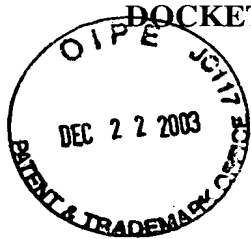
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DOCKET NO.: FCI-2706/C3363

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Yakov Belopolsky and Richard Pon

Application No.: 10/621,288

Filing Date: July 17, 2003

For: ELECTRICAL CONNECTOR AND CONTACT FOR USE THEREIN

Confirmation No.: 2497

Group Art Unit: NOT YET ASSIGNED

Examiner: NOT YET ASSIGNED

DATE OF DEPOSIT:

I HEREBY CERTIFY THAT THIS PAPER IS BEING
FILED CONCURRENTLY WITH THE ATTACHED
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1450.

TYPED NAME: Andrew J. Hagerty
REGISTRATION NO.: 44,141

MS MISSING PARTS

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**PETITION IN SUPPORT OF FILING ON BEHALF OF NON-SIGNING INVENTOR
(37 CFR § 1.47(a))**

1. This is a Petition in Support of Filing on Behalf of a Non-Signing Joint Inventor.
2. This Petition accompanies a Declaration signed by Joint Inventor(s) **Richard Pon** on behalf of non-signing inventor **Yakov Belopolsky**.
3. A Statement including proof of the pertinent facts and the last known address of the non-signing inventor is included herewith.
4. Fee Payment (37 CFR § 1.17(i)):
 - ☒ A check in the amount of **\$130.00** is attached. Please charge any deficiency or credit any overpayment to Deposit Account No. 23-3050.
 - ☐ Please charge Deposit Account No. 23-3050 in the amount of \$.00 . This sheet is attached in duplicate.

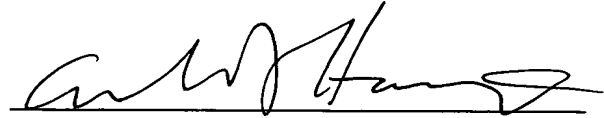
DOCKET NO.: FCI-2706/C3363

- 2 -

PATENT

☒ The Commission is hereby authorized to charge payment of the above fees associated with this communication or credit any overpayment to Deposit Account No. 23-3050. This sheet is attached in duplicate.

Date:



Andrew J. Hagerty
Registration No. 44,141

Woodcock Washburn LLP
One Liberty Place - 46th Floor
Philadelphia PA 19103
Telephone: (215) 568-3100
Facsimile: (215) 568-3439

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DOCKET NO.: FCI-2706/C3363

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Yakov Belopolsky and Richard Pon

For: ELECTRICAL CONNECTOR AND CONTACT FOR USE THEREIN
the specification which:

(check and complete (a), (b) or (c))

- ☐ (a) is attached hereto.
- ☒ (b) was filed on **July 17, 2003**, as Application No. **10/621,288**.
- ☐ (c) was described and claimed in International Application No. _____,
filed on _____, and was amended on _____ (if any).

**STATEMENT OF FACTS IN SUPPORT OF FILING
ON BEHALF OF NON-SIGNING INVENTOR (37 CFR § 1.47)**

This statement is made as to the exact facts that are relied upon to establish the diligent effort made to secure the execution of the declaration by the nonsigning inventor for the above-identified patent application before deposit thereof in the Patent and Trademark Office.

(check next item, if applicable)

- ☐ Because signing on behalf of the nonsigning inventor is by a person or entity showing a sufficient proprietary interest, this statement also recites facts as to why this action was necessary to preserve the rights of the parties or to prevent irreparable damage.

This statement is being made by the available person having first-hand knowledge of the facts recited therein.

IDENTIFICATION OF PERSON MAKING THIS DECLARATION OF FACTS

Dean E. Geibel
Assistant Patent Counsel
FCI USA, Inc.
825 Old Trail Road
Etters, PA 17319

LAST KNOWN ADDRESS OF THE NONSIGNING INVENTOR


Yakov Belopolsky
2407 West Bayberry Drive
Harrisburg, PA 17112

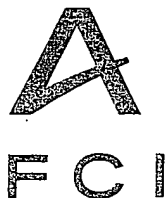
**DETAILS OF REFUSAL OF NONSIGNING INVENTOR
TO SIGN APPLICATION PAPERS**

I, Dean E. Geibel, hereby declare and say:

1. I am a patent attorney (Reg. No. 42,570) employed by FCI USA, Inc., 825 Old Trail Road, Etters, PA 17319.
2. On information and belief, U.S. patent application serial number 10/621,288 entitled "Electrical Connector And Contact For Use Therein" was filed in the U.S. Patent and Trademark Office on July 17, 2003, and included an unsigned Declaration naming Yakov Belopolsky and Richard Pon as inventors of the subject matter claimed therein.
3. On information and belief, at the time the application was filed, only Mr. Pon was in the employ of a FCI company. Mr. Belopolsky's employment was terminated on June 21, 2002.
4. On information and belief, Mr. Pon executed a Declaration (Attachment A) on or about July 24, 2003.
5. On or about July 23, 2003, Mr. Belopolsky was sent a certified mail package that included, among other things, a copy of the patent application, a Declaration, and a letter requesting that he sign and return the Declaration (collectively Attachment B).
6. On or about July 28, 2003, I received a reply letter (Attachment C) from Mr. Belopolsky acknowledging receipt of the package, and agreeing to sign and return the Declaration and Assignment only upon FCI's agreement to remit consideration of the sum of eight hundred dollars (\$800.00 US).
7. On information and belief, Mr. Belopolsky executed an Intellectual Property Agreement (Attachment D) during his employ with FCI. In accordance with at least provisions (2) and (4) of the Agreement, Mr. Belopolsky is obligated, without further consideration, to execute and deliver in a prompt manner all proper documents necessary and attendant to domestic and foreign patent applications, which includes the Declaration. It is my belief that further attempts to secure Mr. Belopolsky's signature in accordance with his obligation under the Intellectual Property Agreement (i.e., without further consideration) are not likely to be successful. Accordingly, in order to complete the filing of the above-referenced application, I believe it necessary to file this application in accordance with 37 C.F.R. § 1.47(a).

Date: 11 DECEMBER 2003


Dean E. Geibel
USPTO Reg. No. 42,570



21 July 2003

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Yakov Belopolsky
2407 West Bayberry Drive,
Harrisburg, PA 17112 USA

**RE: Patent Application entitled:
ELECTRICAL CONNECTOR AND CONTACT FOR USE THEREIN
Our Ref.: C3363**

Dear Yakov :

We recently filed a Patent Application with the U.S. Patent & Trademark Office naming you as an inventor. Find enclosed a packet which contains an Assignment, a Declaration for Patent Application, and a copy of the application.

Verify the information appearing in the Declaration and the Assignment. If accurate, then sign the Declaration; sign the Assignment in the presence of a witness; and post the packet in the enclosed postage paid return envelope. If either form includes an inaccuracy, then contact me before signing.

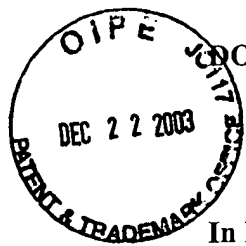
Also enclosed are documents for filing your application in China and Taiwan. Please sign and date the Chinese and Taiwanese Oath/Assignment where indicated. You will note the Chinese Assignment has been predated in accordance with Chinese requirements.

If you have any additional questions, please feel free to contact me.

Very Truly Yours,

Dean E. Geibel
Assistant Patent Counsel

Enclosure: Postage Paid Return Envelope
Packet, including:
US Declaration for Patent Application with attached Patent Application
US Assignment
Taiwanese Oath
Chinese Assignment



DOCKET NO.: FCI-2706/C3363

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of Yakov Belopolsky and Richard Pon

For: Electrical Connector And Contact For Use Therein

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is for the following type of application:

(check one applicable item below)

- | | |
|---|---|
| <input checked="" type="checkbox"/> Original | <input type="checkbox"/> Divisional |
| <input type="checkbox"/> Continuation | <input type="checkbox"/> U.S. National Stage of PCT |
| <input type="checkbox"/> Continuation-in-Part | |

My residence, post office address and citizenship are as stated below next to my name; and I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a

- | | |
|--|--|
| <input checked="" type="checkbox"/> Utility Patent | <input type="checkbox"/> Design Patent |
|--|--|

is sought on the invention, whose title appears above, the specification of which:

- | | |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | is attached hereto |
| <input type="checkbox"/> | was filed on _____, as U.S. Serial Number _____ |
| <input type="checkbox"/> | and was amended on _____ (if applicable) |
| <input type="checkbox"/> | was described and claimed in PCT International Application Number _____, filed on _____ and as amended under PCT Article 19 on _____ and/or PCT Article 34 on _____. |

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to be material to the patentability of this application in accordance with 37 CFR § 1.56.

**DISCLOSURE AND/OR CLAIM FOR PRIORITY UNDER
35 U.S.C. §§ 119(a)-(d) OF FOREIGN APPLICATIONS
FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN)
OF THIS APPLICATION**

I hereby claim foreign priority benefits under Title 35, United States Code §§ 119(a)-(d) of any foreign applications for patent, inventor's certificate or PCT international application designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent, inventor's certificate or any PCT international application designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

Country (or indicate if PCT)	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 37 USC 119a-d
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No

**DISCLOSURE OF FOREIGN APPLICATION(S) IF ANY,
FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN)
PRIOR TO THE FILING OF THIS APPLICATION**

Country (or indicate if PCT)	Application Number	Date of Filing (day, month, year)

**CLAIM FOR PRIORITY OF UNITED STATES APPLICATIONS
OR PCT APPLICATIONS FILED
IN THE UNITED STATES RECEIVING OFFICE
UNDER 35 U.S.C. §120**

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to be material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Application No.	Date Filed	Status Patented/Pending/Abandoned

**CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)
UNDER 35 U.S.C. § 119(e)**

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Provisional Application Number	Filing Date
60/399,637	July 30, 2002

POWER OF ATTORNEY

- ☒ I hereby appoint all the practitioners associated with Customer Number 23377 (which is the Customer Number assigned to Woodcock Washburn LLP) to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith. Each practitioner associated with Customer Number 23377 is an attorney registered before the United States Patent and Trademark Office.

23377**23377**

PATENT TRADEMARK OFFICE

- ☒ I also appoint the following persons of **FCI USA, INC.**, 825 Old Trail Road, Etters, Pennsylvania 17319 as attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Attorney/Patent Agent	Registration No.
M. Richard Page, Esq.	25,299
Dean E. Geibel	42,570

Address all telephone calls, correspondence and maintenance fee correspondence to:

Andrew J. Hagerty
WOODCOCK WASHBURN LLP
One Liberty Place - 46th Floor
Philadelphia PA 19103
Telephone No.: **(215) 568-3100**
Facsimile No.: **(215) 568-3439**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first joint inventorYakov*(Given Name)*(Middle Initial or Name)Belopolsky*Family (or last name)*City/State of Actual Residence: Harrisburg, PennsylvaniaMailing Address: 2407 West Bayberry DriveHarrisburg, Pennsylvania 17112Country of Citizenship: United States of America

Inventor's signature: _____

Date: _____

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of second joint inventor

Richard
(Given Name)

(Middle Initial or Name)

Pon
Family (or last name)

City/State of Actual Residence: Long Tan Village, Taoyuan County

Mailing Address: 18F-5, N°41, Bai Nian Road
Long Tan Village, Taoyuan County

Country of Citizenship: Republic of China

Inventor's signature:_____

Date: _____

ELECTRICAL CONNECTOR AND CONTACT FOR USE THEREIN**RELATED APPLICATION**

[0001] This application claims the benefit of U.S. Provisional Application No. 60/399,637 filed on July 30, 2002.

FIELD OF THE INVENTION

[0002] The invention generally relates to electrical contacts and connectors. Preferred connectors are particularly useful for connecting multiple circuit boards together, and for providing electrical contact in high power applications.

BACKGROUND OF THE INVENTION

[0003] Electrical connectors include contacts for engaging printed circuit boards. The boards may employ holes into which contact mating portions or tails are inserted. Low insertion forces can be achieved by having larger hole dimensions relative to the dimensions of the contact tails. For a fixed arrangement, solder can be added to provide retention of the contact tails once inserted into the board holes. For a removable arrangement, solder may or may not be desirable. In the absence of solder (or a substantial amount of solder), the relative dimensions of contact tails and board holes can be such that a press fit is provided. While adequate retention is accomplished through a press fit, insertion forces may be comprised. Accordingly, there is room for improvement in the art.

SUMMARY OF THE INVENTION

[0004] The present invention is directed to electrical contacts. Preferred contacts have a contact leg that has a mating portion including features that provide good electrical contact, relatively low insertion force into a printed circuit board through hole, and adequate retention within the through hole. In at least some of the preferred embodiments, the contact leg includes two beams, a first beam for fine adjustment of contact forces and a second beam for contact and retention force.

[0005] In accordance with one preferred embodiment of the present invention, there has now been provided a contact for an electrical connector, the contact having a first contact leg, a second contact leg arranged in a substantially mirror relationship with the first contact leg, and a connecting member extending between and being integral with the first contact leg and the second contact leg. Each of the contact legs includes a mating portion for engagement with one of a pair of spaced apart circuit board through holes disposed in a single circuit board. The mating portion includes an elastically deformable beam for imparting a normal force onto a wall of a circuit board through hole upon engagement of the mating portion with a circuit board.

[0006] In accordance with another preferred embodiment of the present invention, there has now been provided a contact for an electrical connector, the contact having a first contact leg, a second contact leg spaced apart from the first contact leg, and a connecting member extending between the first contact leg and the second contact leg and being integral therewith. Each of the contact legs includes a mating portion for engaging one of a pair of circuit board through holes. The mating portion comprises at least one hinge that facilitates elastic deformation of the mating portion upon engagement of the mating portion with a wall of a circuit board through hole.

[0007] In accordance with yet another preferred embodiment of the present invention, there has now been provided a contact for an electrical connector, the contact having a mating portion for engagement with a circuit board through hole. The mating portion includes a beam having a shoulder region extending orthogonal to a longitudinal contact axial line for limiting insertion depth of the mating portion, a discrete engaging area for imparting a normal force onto a wall of a circuit board through hole, and a hinge formed in the shoulder region that facilitates elastic deformation of at least some of the mating portion upon engagement of the discrete engaging area with a wall of a circuit board through hole.

[0008] The present invention is also directed to electrical connectors. Preferred electrical connectors act as interface connectors for connecting circuit boards together while reducing inductance and increasing current carrying capacity. Preferred connector embodiments include an insulative housing having passages that are capable of accepting a plurality of contacts, including the preferred contact embodiments described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The foregoing summary, as well as the following detailed description of preferred embodiments, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings exemplary constructions of the invention; however, the invention is not limited to the specific features disclosed. In the drawings:

[0010] Fig. 1 is a perspective view of an exemplary contact having opposing mating portions for connecting a pair of circuit boards, one of the mating portions has a hinge to facilitate elastic deformation of the same;

[0011] Fig. 2 is a perspective view of a similar contact to that shown in Fig. 1, with one of the opposing mating portions being angled;

[0012] Fig. 3A is a partial front view of another exemplary contact including a mating portion having two hinges to facilitate elastic deformation of at least some of the mating portion upon insertion into circuit board through holes;

[0013] Fig. 3B is a partial front view of an alternative contact embodiment to the contact shown in Fig. 3A, wherein the alternative contact embodiment includes only a single contact leg;

[0014] Fig. 4 is a perspective view of a preferred electrical connector having a plurality of contacts arranged in an insulative housing;

[0015] Fig. 5 is a perspective view of the electrical connector of Fig. 4 connected to a first circuit board and disengaged from and arranged above a second circuit board;

[0016] Figs. 6A-6C is a series of partial cross-sectional views of a preferred contact being inserted into circuit board through holes; and

[0017] Figs. 7A-7C is a series of partial cross-sectional views of another preferred contact being inserted into circuit board through holes.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] Interface connectors for connecting multiple circuit boards together are provided. A typical circuit substrate such as a microprocessor board can include traces or pads for, for example, cache, power, and return traces. It is desirable to connect the circuit

board to another circuit substrate such as a power board. Typically, the cache, the power, and the return traces connect to suitable conductive elements on the power board. It is desirable to reduce the inductance between the interconnection of the boards, while at the same time, increase the current carrying capacity. It is understood that the arrangement of cache, power, and return traces could be varied as desired by the circuit board designer.

[0019] The present invention is believed to be best understood through the following detailed description of preferred embodiments and the accompanying drawings wherein like reference numbers indicate like features. Referring to Figs. 1 and 2, an exemplary contact 10 is shown comprising a pair of contact legs 11 and 12, preferably in mirror relationship with each other, although this is not a requirement. A connecting member 20 couples contact leg 11 to contact leg 12. Contact leg 11, contact leg 12 and connecting member 20 are preferably integral components (i.e., formed together as a single unit). The preferred integral configuration of contacts legs 11, 12 and connecting member 20 facilitates good electrical connection and high power application.

[0020] Each of the contact legs 11, 12 has opposing mating portions 31, 32 and 41, 42, respectively, for engagement with a printed circuit board, either removably or fixed (e.g., with solder). Mating portions 31, 32 can both engage a board on the same side of the board, or on opposite sides of the board. Similarly, mating portions 41, 42 can both engage a board on the same side of the board, or on opposite sides of the board. As shown in the figures, mating portions 31 and 32 (and 41 and 42) are preferably substantially parallel to each other, though this is not a requirement. It is to be understood that the present invention contemplates leg to leg variations encompassed within the mating portions although not illustrated in the figures herein.

[0021] Mating portions 31, 32 are preferably configured for a soldered connection to a circuit board, whereas mating portions 41, 42 are preferably configured for a solder-free connection (although some solder may be utilized with mating portions 41, 42). Alternative embodiments (not shown) include opposing mating portions that are both configured for a solder-free connection to a circuit board, such as through employment of opposing mating portions similarly designed to that of mating portions 41, 42. It is contemplated that the mating portions can be either straight, angled, or have any other suitable arrangement, depending on the circuit boards the connector is to interconnect. By

way of example, mating portions 31, 32 have a straight orientation in Fig. 1, and are angled substantially at 90 degrees in Fig. 2.

[0022] Referring now to Fig. 1, engagement portions 41, 42 are preferably configured for a solder-free connection to permit engagement and disengagement with a circuit board as desired. Mating portions 41, 42 include features that provide a relatively low insertion force into a circuit board through hole, while maintaining sufficient retention therein. As described in more detail below, the balance of low insertion force and sufficient retention is preferably provided through one or more elastically deformable beams, and one or more hinges that facilitate elastic deformation and/or deflection of at least some of mating portions 41, 42 upon insertion into a circuit board through hole. The elastic deformation results in mating portion 41, 42 imparting a normal or retentive force on a through hole sidewall. "Elastic deformation" as used herein means substantially non-plastic or non-permanent deformation (that is, the contact should return to its original geometry when disengaged from a circuit board through hole – although, a minor amount of plastic deformation is allowed). "Hinge" as used herein includes, but is not limited to, bends, arches, indentations, scores, weakened areas, relieved areas and the like.

[0023] Contact legs 11 and 12 each include at least two beams, with at least a portion of each of the two beams residing in mating portions 41 and 42, respectively. Employing two beams can provide good electrical contact in high power applications, and can provide adjustment ("tuning") of contact and retentive forces. Contact leg 11 has a first beam 50 and a second beam 52 extending therefrom. In a preferred embodiment, first beam 50 includes an angled section 53 that is angled outwardly and away from a longitudinal contact axial line 15, and second beam 52 includes an angled section 54 that is angled inwardly and toward axial line 15. Angled sections 53 and 54 help to define discrete engaging areas 70 and 71 for contacting a wall of a circuit board through hole. Discrete engaging areas can help minimize insertion force through reduced friction when mating portion 41 is inserted into circuit board through hole. Similarly, contact leg 12 has a first beam 60 and a second beam 62. First beam 60 includes angled section 63, while second beam 62 includes angled section 64. Mating portion 42 is shown having discrete engaging areas 80 and 81. It is to be understood, that mating portions 41 and 42 each may

include more than two beams, and may include a single discrete engaging area or more than two discrete engaging areas.

[0024] Mating portions 41, 42 preferably include one or more hinges to facilitate elastic deformation or deflection of at least some of the mating portions upon insertion into a circuit board through hole. Exemplary contact 10, shown in Figs. 1 and 2, employs a single hinge in each of the mating portions 41 and 42. Mating portion 41 has a hinge 58 disposed proximate the intersection of beams 50 and 52, while mating portion 42 has a hinge 68 disposed proximate the intersection of beams 60 and 62.

[0025] Another exemplary contact 110 is shown in Fig. 3A. Contact 110 includes similar features to that of contact 10, with the similar features being labeled with the same reference characters in the hundred series. Each of the mating portions 141 and 142 of contact 110 employs two hinges to facilitate elastic deformation or deflection. By way of example, mating portion 141 (142) has a first hinge 158 (168) disposed proximate the intersection of first beam 150 (160) and second beam 152 (162), and a second hinge 159 (169) disposed in a shoulder region 190 (191) that limits an insertion depth of the contact into a circuit board through hole. Preferably, each of hinges 158 and 159 facilitate elastic deformation or lateral deflection of at least some of mating portion 141 upon insertion into a circuit board through hole. Hinges 158 (168) and 159 (169) may facilitate elastic deformation or lateral deflection of mating portion 141 (142) in a single direction. The two hinges may, alternatively, facilitate elastic deformation or lateral deflection in opposing directions. That is, one region of mating portion 141 (142) may deflect inwardly toward contact axial line 115 via one of the hinges, and another region of mating portion 141 (142) may deflect outwardly and away from contact axial line 115 via the other hinge.

[0026] Alternative contacts contemplated by the present invention have only a single contact leg. By way of example and with reference to Fig. 3B, contact 610 is illustrated, which contains similar features to those of contact 110 shown in Fig. 3A, but instead of having two contact legs, has a single contact leg 611. Contact leg 611 includes a beam 660 having a shoulder region 690, a discrete engaging area 680, and a hinge 669 formed in shoulder region 690 that facilitates elastic deformation and/or deflection of beam 660 upon the discrete engaging area 680 contacting a wall of a circuit board through hole.

[0027] The hinges and discrete engaging areas can (independently or collectively) provide a balance of low insertion force and adequate retention in a circuit board through hole. The hinges and discrete engaging areas can help minimize insertion forces. Elastic deformation or deflection of the mating portions, via the hinges, can also help retention because the deformation or deflection results in beam engaging areas imparting a normal force or retentive force on a circuit board through hole sidewall.

[0028] Referring now to Figs. 4 and 5, an electrical connector 200 for connecting multiple circuit boards together is shown. Electrical connector 200 includes an insulative housing 210 having a plurality of contacts, such as, for example, preferred contacts 10 or 110, disposed therein. The plurality of contacts may be similar or dissimilar to each other. As can be seen in Fig. 5, connector 200 is engaged with a first circuit board 300 and disengaged from a second circuit board 310. The circuit boards 300 and 310 will be connected by connector 200 in an orthogonal configuration; however, a parallel interconnection is also contemplated by the present invention by employing contacts with straight mating portions on both ends thereof. In a preferred embodiment, the contacts disposed in connector 200 include mating portions configured for a soldered connection to board 300 and opposing mating portions configured for a solder-free (press-fit) connection to board 310. Alternatively, both mating portions may be configured for a solder-free connection to a respective circuit board.

[0029] Exemplary dynamics or interaction of contact mating portions with circuit board through holes will be discussed with reference to Figs. 6A-6C and 7A-7C. Referring first to the partial cross-sectional views of Figs. 6A-6C, an exemplary contact 410 having a first contact leg 411 and an second contact leg 412 is shown. Each of the contact legs 411 and 412 has a first discrete engaging area 470 and 480, respectively, that engages a wall 420 of circuit board through holes 415, 416 upon partial insertion of contact 410. When the first discrete engaging areas 470, 480 engages a region of wall 420, mating portions 441, 442 elastically deform or deflect in a direction LD1. Elastic deformation or deflection is facilitated by employment of hinges 458, 468. Upon further insertion of contact 410 into through holes 415, 416, second discrete engaging area 471, 481 engage an opposing region of wall 420 such that mating portions 441, 442 deform or deflect in a direction LD2 via hinge 458, 468.

[0030] Referring to Figs. 7A-7C, another exemplary contact 510 is configured to include a pair of contact legs 511 and 512, with each of the contact legs including a mating portion 541 and 542, respectively. Each of mating portions 541, 542 includes two hinges 558, 568 and 559, 569, respectively, and a single discrete engaging area 570, 571, respectively, for engaging wall 520 of circuit board through hole 515, 516. Hinges 558, 559, 568 and 569 preferably facilitate respective elastic deformation or deflection in a direction LD3. The dynamics described with reference to Figs. 6A-6C and 7A-7C are illustrative only, and are not limiting. That is, the dynamics can vary depending on the configuration of alternative contact embodiments and the configuration of circuit though holes to be engaged.

[0031] Preferred contacts of the present invention may be stamped or otherwise formed from materials known by those of ordinary skill in the art. Suitable contact materials includes, but is not limited to, phosphor bronze alloys, beryllium copper alloys and high conductivity copper alloys. The contacts may be plated with known materials as well, including gold, or a combination of gold and nickel. The insulative housing of preferred connectors of the present invention may be molded or formed from a glass-filled high temperature nylon or other materials known to one having ordinary skill in the art. The contacts can be inserted into passages of the housing after it is molded, or the housing may be formed around an array of contacts.

[0032] It is to be understood that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only. Accordingly, changes may be made in detail, especially in matters of shape, size and arrangement of features within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

WHAT IS CLAIMED IS:

1. A contact for an electrical connector, the contact comprising:
 - a) a first contact leg;
 - b) a second contact leg arranged in a substantially mirror relationship with the first contact leg; and
 - c) a connecting member extending between and being integral with the first contact leg and the second contact leg;wherein each of the first contact leg and the second contact leg includes a mating portion for engagement with one of a pair of spaced apart circuit board through holes disposed in a single circuit board, the mating portion comprising an elastically deformable beam for imparting a normal force onto a wall of a circuit board through hole upon engagement of the mating portion with a circuit board.
2. The contact of claim 1, wherein the elastically deformable beam includes a hinge that facilitates elastic deformation of the elastically deformable beam.
3. The contact of claim 1, wherein the elastically deformable beam includes a shoulder region for limiting insertion depth of the mating portion into a circuit board through hole.
4. The contact of claim 3, wherein a hinge is formed in the shoulder region.
5. The contact of claim 1, wherein the mating portion further comprises a second beam extending from the elastically deformable beam.
6. The contact of claim 5, wherein an intersection of the elastically deformable beam and the second beam defines a discrete engaging area such that friction between the contact mating portion and a circuit board through hole is minimized.
7. The contact of claim 6, wherein the second beam includes a second discrete engaging area that is transversely offset from the discrete engaging area.

8. The contact of claim 1, wherein the mating portion includes first and second discrete engaging areas for engaging a wall of a circuit board through hole.
9. The contact of claim 8, wherein the first discrete engaging area is vertically and transversely offset from the second discrete engaging area.
10. The contact of claim 1, wherein each of the first contact leg and the second contact leg includes an opposing mating portion for a soldered connection with a circuit board.
11. A contact for an electrical connector, the contact comprising:
 - a) a first contact leg;
 - b) a second contact leg spaced apart from the first contact leg;
 - c) a connecting member extending between the first contact leg and the second contact leg and being integral therewith;wherein each of the first contact leg and the second contact leg includes a mating portion for engaging one of a pair of circuit board through holes formed in a single circuit board, the mating portion comprising at least one hinge that facilitates elastic deformation of the mating portion upon engagement of the mating portion with a wall of a circuit board through hole.
12. The contact of claim 11, wherein the mating portion further comprises a first beam and a second beam extending therefrom, each of the first beam and the second beam including a section that is angled with respect to a longitudinal contact axial line.
13. The contact of claim 12, wherein the angled section of the first beam is angled in a different direction than the angled section of the second beam.

14. The contact of claim 12, wherein the at least one hinge is disposed proximate an intersection of the first beam and the second beam.
15. The contact of claim 12, wherein the first beam comprises a second hinge.
16. The contact of claim 15, wherein the first beam includes a shoulder oriented orthogonal to the longitudinal contact axial line for limiting insertion depth of the mating portion into a circuit board through hole.
17. The contact of claim 16, wherein the second hinge is disposed in the shoulder.
18. The contact of claim 11, wherein the mating portion consists of a first discrete engaging area and a second discrete engaging area for engaging a wall of a circuit board through hole.
19. The contact of claim 18, wherein the first discrete engaging area is both vertically and transversely offset from the second discrete engaging area.
20. A contact for an electrical connector, the contact comprising:
 - a contact leg including a mating portion for engagement with a circuit board through hole, the mating portion including a beam comprising:
 - a) a shoulder region extending orthogonal to a longitudinal contact axial line for limiting insertion depth of the mating portion into a circuit board through hole;
 - b) a discrete engaging area for imparting a normal force onto a wall of a circuit board through hole; and
 - c) a hinge formed in the shoulder region that facilitates elastic deformation of at least some of the mating portion upon engagement of the discrete engaging area with a wall of a circuit board through hole.

21. The contact of claim 20, further comprising a second contact leg that is arranged in a substantially mirror relationship with the contact leg, and a connecting member coupling the second contact leg to the contact leg.
22. The contact of claim 21, wherein the contact leg, the second contact leg, and the connecting member are integral.
23. The contact of claim 21, wherein the second contact leg has a mating portion that is configured similar to that of the contact leg.
24. The contact of claim 23, wherein the mating portion of each of the contact leg and the second contact leg further comprises a second discrete engaging area that is laterally and vertically offset from the discrete engaging area.
25. An electrical connector comprising:
an insulative housing; and
a contact according to claim 1 disposed in the insulative housing.
26. An electrical connector comprising:
an insulative housing; and
a contact according to claim 11 disposed in the insulative housing.
27. An electrical connector comprising:
an insulative housing; and
a contact according to claim 20 disposed in the insulative housing.

ABSTRACT OF THE DISCLOSURE

Electrical connectors and contacts for engaging printed circuit boards are disclosed. One preferred contact has a first contact leg, a second contact leg arranged in a substantially mirror relationship with the first contact leg, and a connecting member extending between and being integral with the first contact leg and the second contact leg. Each of the contact legs includes a mating portion for insertion into a circuit board through hole. The mating portions have an elastically deformable beam for imparting a normal force onto a wall of a circuit board through hole.

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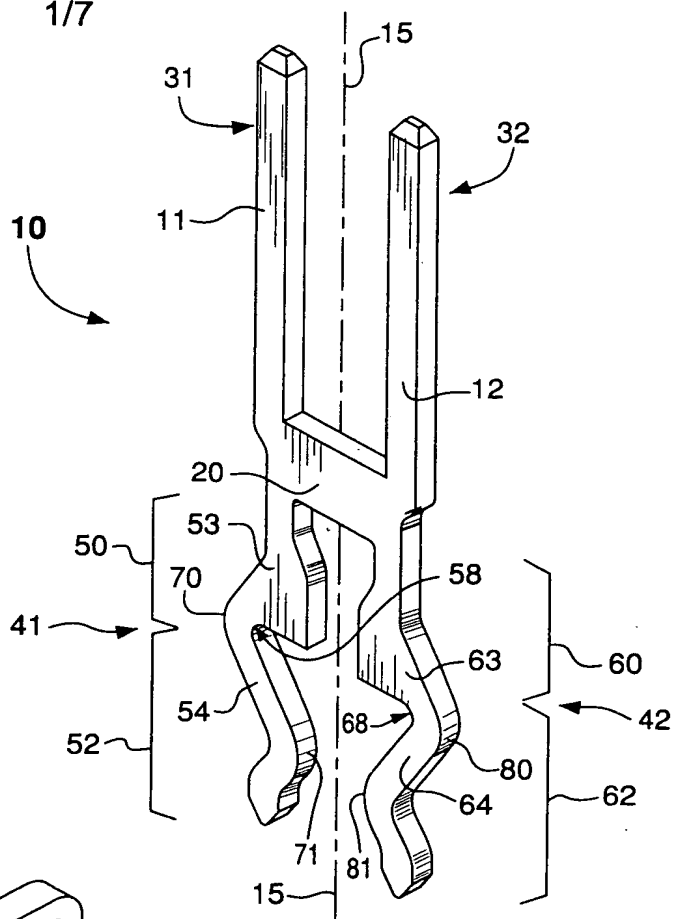


FIG. 1

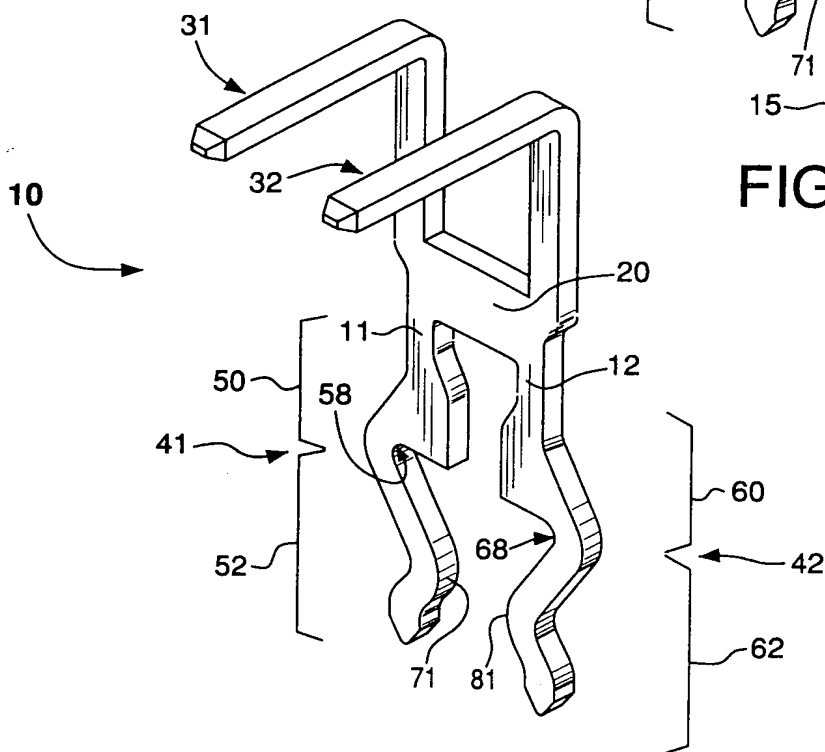


FIG. 2

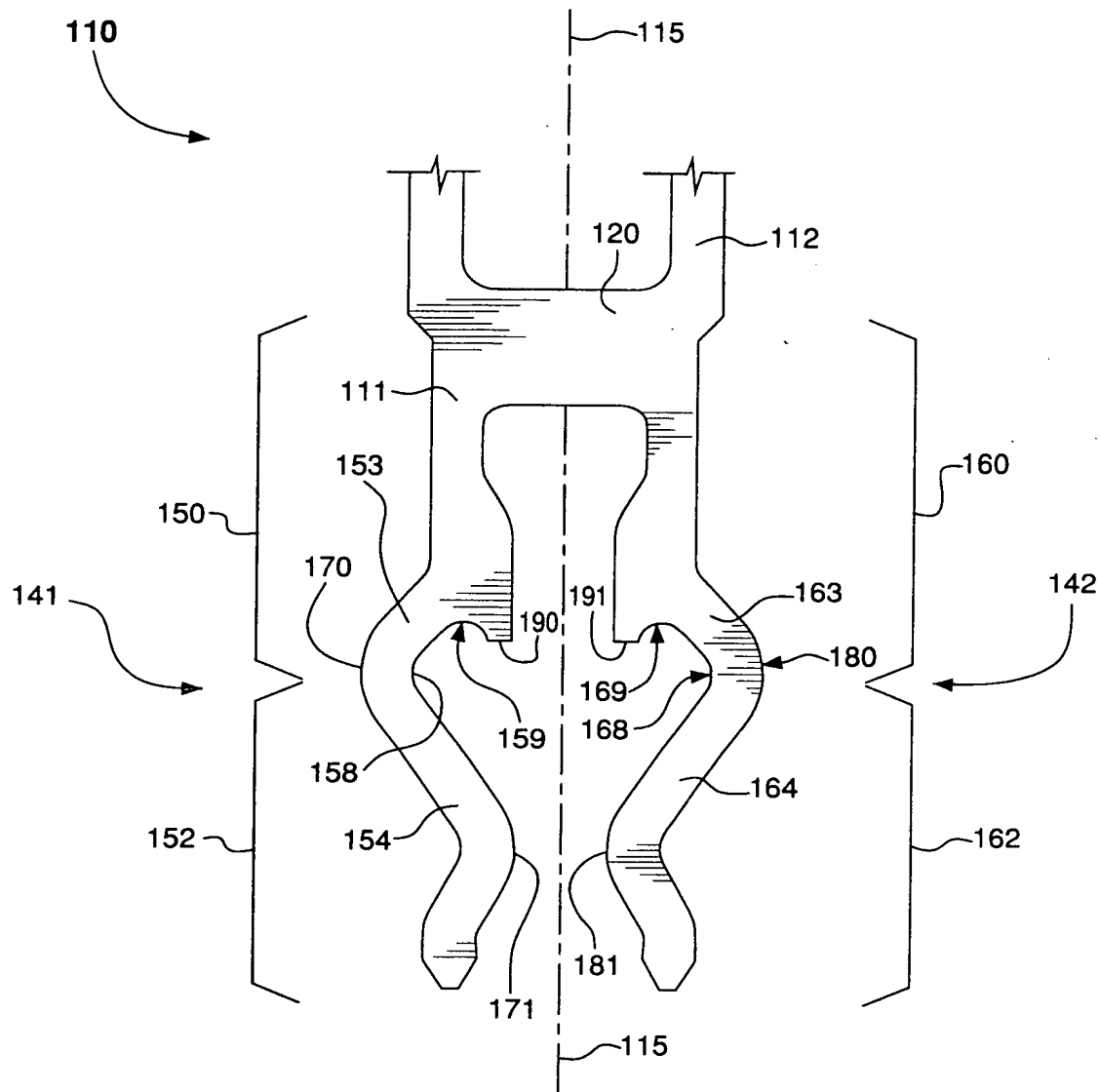


FIG. 3A

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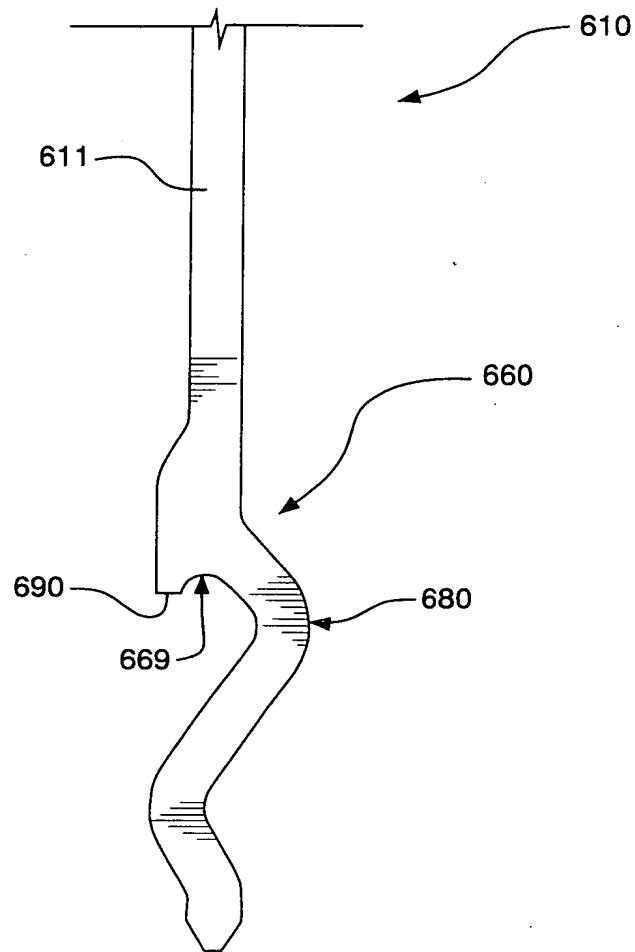


FIG. 3B

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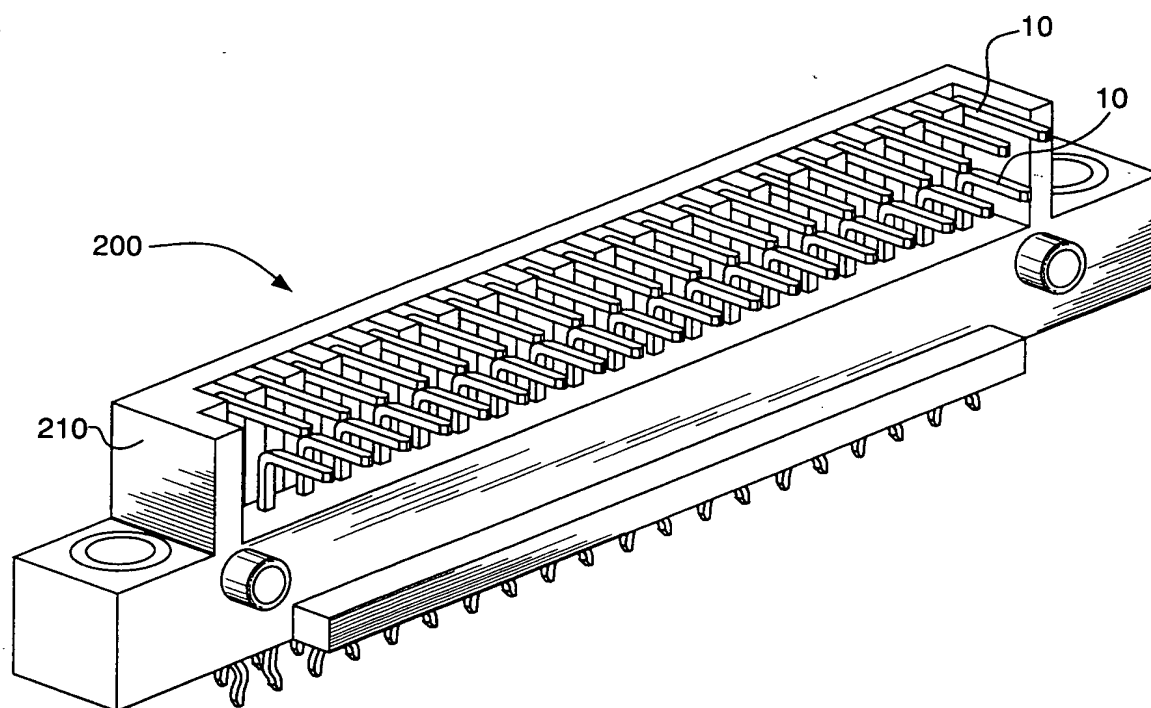


FIG. 4

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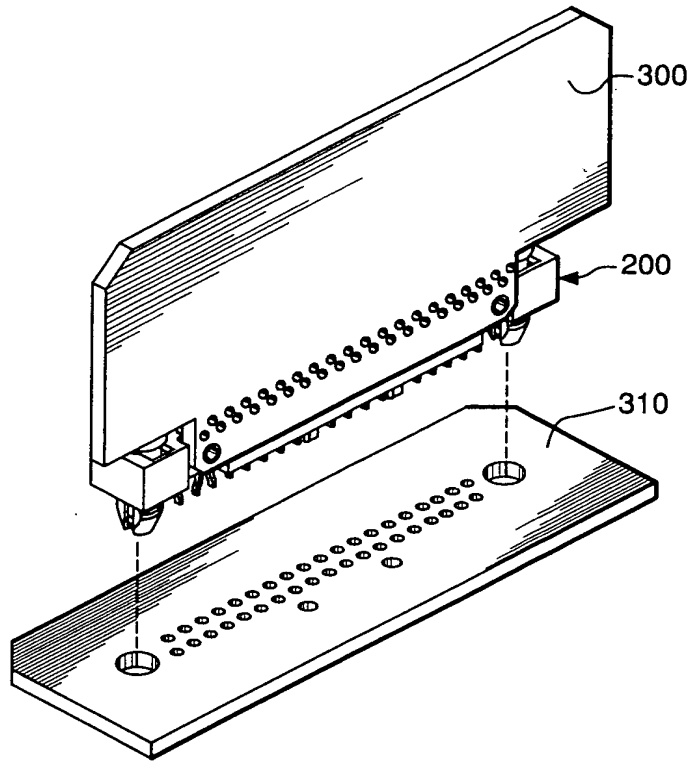


FIG. 5

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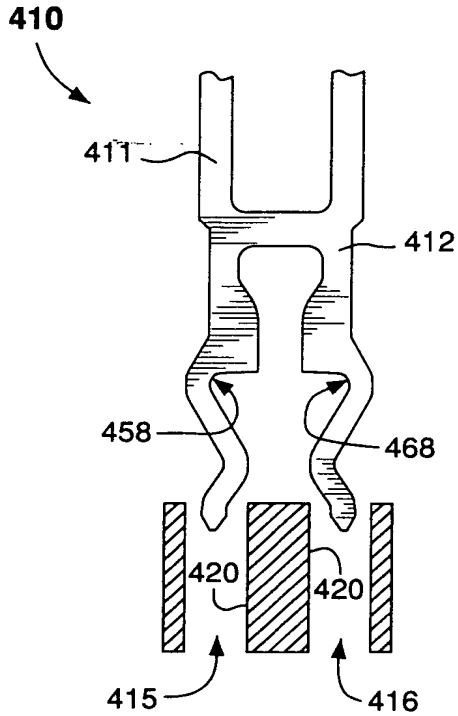


FIG. 6A

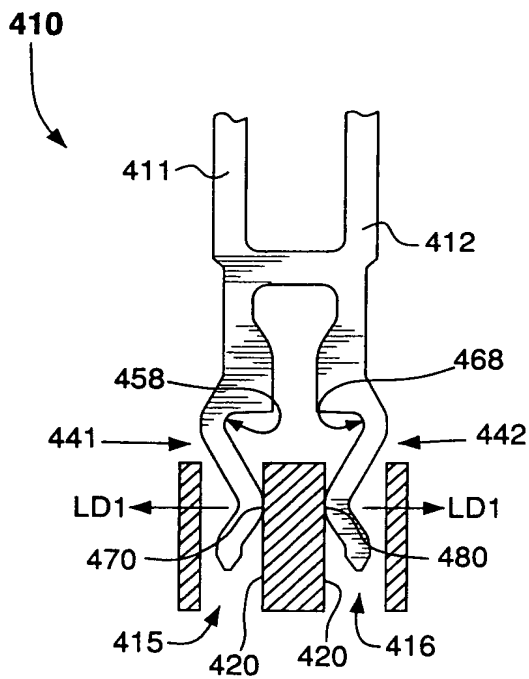


FIG. 6B

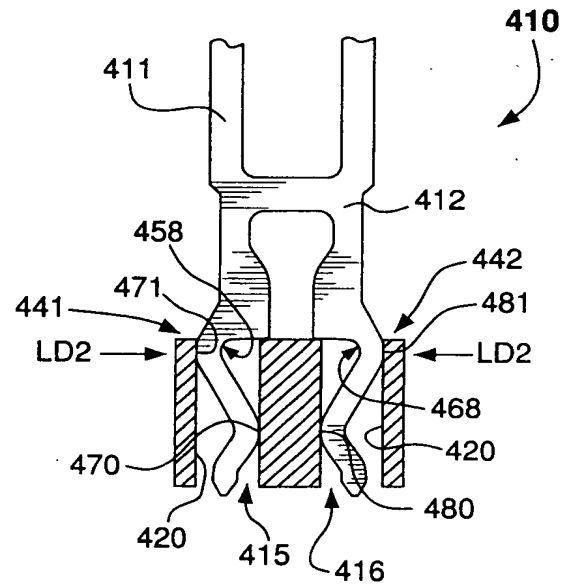


FIG. 6C

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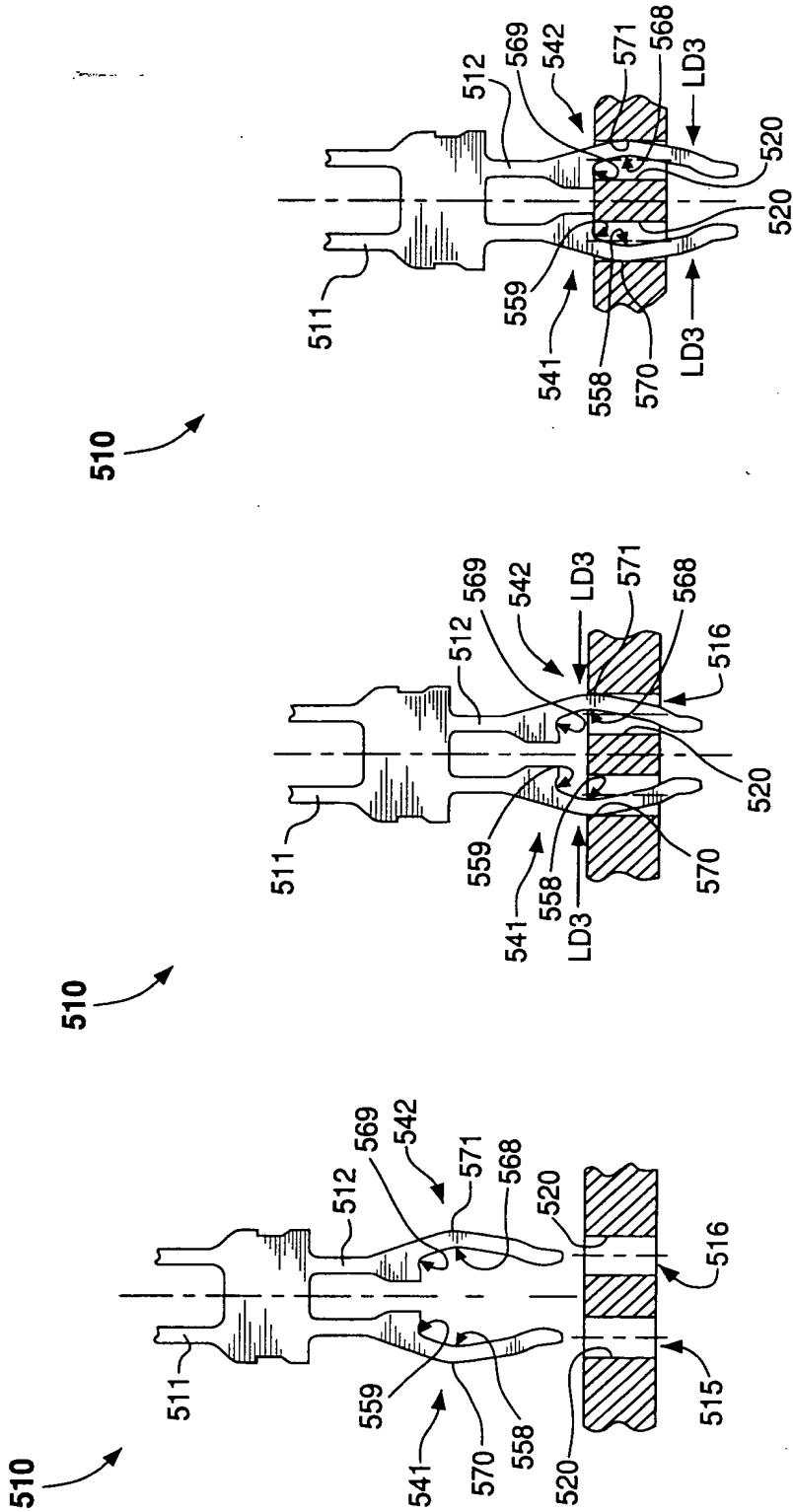
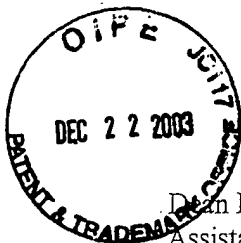


FIG. 7C

FIG. 7B

FIG. 7A



CERTIFIED MAIL

Dean E. Geibel
Assistant Patent Counsel.
FCI USA Inc
825 Old Trail Road
Etters, PA 17319

RECEIVED
JUL 28 2003
IP LAW

Re: Patent Application
ELECTRICAL CONNECTOR AND CONTACT FOR USE THEREIN
Ref. C3363

July 23, 2003

Dear Dean,

This is to acknowledge that I received your letter and the following documents

- US Assignment (4 pages)
- Oath and Assignment
- Taiwanese Oath
- Chinese Assignment
- Declaration and Power of Attorney (6 pages)
- Patent Application (13 pages)
- Patent illustrations (7 pages)

You are asking me, the inventor of the invention described in the above listed documents, to assign and transfer to FCI Americas Technology Inc. all the rights, title and interest to this invention.

Also, in your letter you are asking me to verify the information and sign the documents in the presence of a witness and post the documents through express mail.

I am willing to accommodate a reasonable request and will be happy to help you.

In consideration of the sum of Eight Hundred Dollars (\$800.00 US) I will review the documents, execute the oaths and assignments, and return all the documents to you upon your written confirmation of your agreement to the payment.

Do not hesitate to call me or e-mail if you have any questions.

Truly yours,

Y. Belopolsky July 23, 2003.

Yakov Belopolsky
2407 West Bayberry Drive
Harrisburg PA 17112
Tel. 652-6893 (eve)

belofamy@msa.com

Intellectual Property Agreement

It is recognized by the undersigned that by reason of being employed by Berg Electronics, Inc. (henceforth called "Company"), he or she may develop or create intellectual property such as but not limited to inventions, discoveries, ideas, trade secrets, and or copyrightable material. These intellectual properties may result from or arise out of work performed by the undersigned within the scope of his or her responsibilities, or with the Company's facilities, equipment, or supplies, or result from his or her knowledge of confidential or trade secret information which is proprietary to the Company. In consideration of employment by the Company and of the special opportunities for advancement which may come from such creative work, the undersigned hereby acknowledges the sufficiency of said consideration and assumes, and will carry on his or her employment under the following continuing obligations:

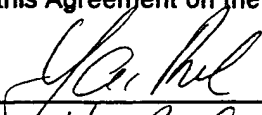
- (1) During the period of said employment, the undersigned agrees to report to the Company fully and promptly in writing, all intellectual property such as, but not limited to: inventions, ideas, discoveries, patentable or unpatentable, trade secrets and copyrightable works which is made, developed, conceived, or reduced to practice by the undersigned within the scope of his or her responsibilities, or with the Company's facilities, equipment, or supplies, or which results from his or her use of knowledge of confidential or trade secret information which is proprietary to the Company.
- (2) Upon termination of said employment, for a period of two (2) years after termination, the undersigned agrees to report to the Company fully and promptly in writing, all intellectual property such as, but not limited to inventions, ideas, discoveries, patentable or unpatentable, trade secrets and copyrightable works; which is made, developed, or conceived by the undersigned either solely or jointly with others wherever such intellectual property reasonably results from the work performed by the undersigned during employment by the Company within the scope of his or her responsibilities, or with the Company's facilities, equipment, or supplies; or results from his or her use or knowledge of confidential or trade secret information which is proprietary to the Company.
- (3) The undersigned agrees to hold all such intellectual property as described in paragraphs (1) and (2), for the benefit of the Company and not assign any rights therein to anyone else.
- (4) The undersigned agrees to assign to the Company upon its request and without further compensation all rights, title, and interest in such intellectual property as described in paragraphs (1) and (2) at any time whether during or subsequent to his or her period of said employment. The undersigned agrees to execute and deliver in a prompt manner all proper documents provided by the Company and presented to the undersigned, including those necessary and attendant to domestic and foreign patent applications, including but not limited to: divisional, continuation, continuation-in-part, substitute and/or reissue applications, and all other instruments for the perfection of intellectual property rights, including related registrations of issued patents, design patent applications and registrations, applications for utility models and industrial models, and copyrights, as well as formal assignments thereof.
- (5) The Company will pay reasonable out-of-pocket expenses incurred by the undersigned in perfecting the Company's rights as they relate to assisting the Company in all proper ways in the acquisition and preservation of the rights to such intellectual property as described in paragraph (4) above.
- (6) All of the covenants and provisions herein contained are severable; in the event that any of the said covenants or provisions shall be held by any court of competent jurisdiction to be invalid or unenforceable. This agreement shall be construed as if any such invalid or unenforceable covenant or provision were not herein contained.
- (7) The undersigned covenants that there are no unpatented inventions, discoveries, ideas, or information to be withheld from operation of the agreement except items as listed on the reverse side of the sheet and there approved by an authorized representative of the Company.
- (8) This agreement is separate from and does not replace or alter the Confidentiality Agreement between the Company and the undersigned.

Intending to be legally bound, the undersigned has executed this Agreement on the date indicated below.

Date:

Jan 20, 98

Signed:



Name:

Y. Belopolsky
(printed)

Witness:

